SES Guidance EV only

F.3.1-4 Tube Chassis

Accumulator Side Protection,
Tractive and HV side Protection (EV only)
Rear Impact Protection (EV only)

Accumulator Side Protection

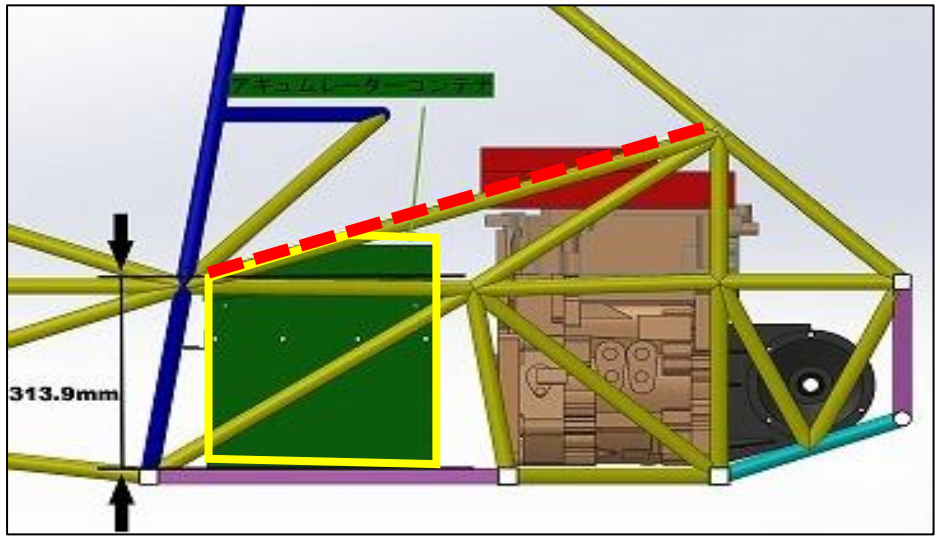
Last year's rule.

BLANK Accumulator Side Protection,
Tractive and HV Side Protection (EV Only)

BLANK					
F.11.2.1.a Accumulator Side Protection		**Minimum**	**Tube Used**		EQ
F.3.2.1.m	Example: 25.4mm x 1.6mm round	Size B	Round		EQ
F.3.4.1.b	Wall thickness:	1.2		mm	BLANK
	Outer Diameter (OD):	25		mm	BLANK
	Wall thickness:	1.2		mm	BLANK
	Outer Diameter (OD):	25.0		mm	BLANK
	Tube cross sectional area (A):	114		mm^2	BLANK
	Tube second moment of inertia (I):	8509		mm^4	BLANK

A pipe of the same size diameter and wall thickness as the SIS is required.

Yellow line is ACC.
Example of adding a pipe (red dashed line) to establish Side Protection.

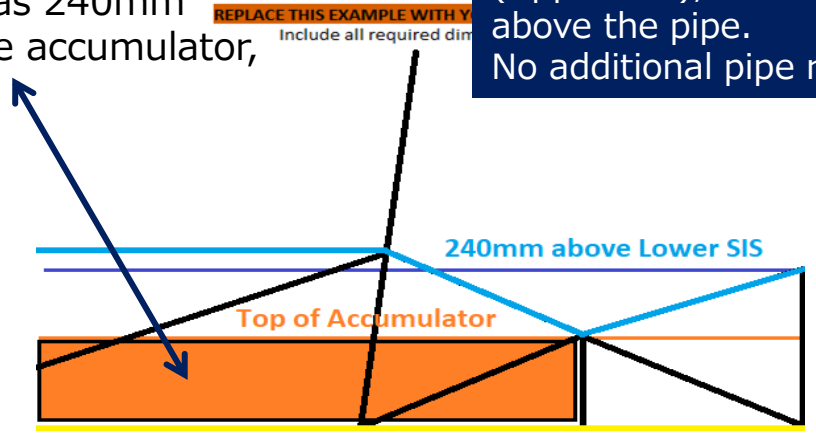


New rule.
Ver2.0 2022.11.7

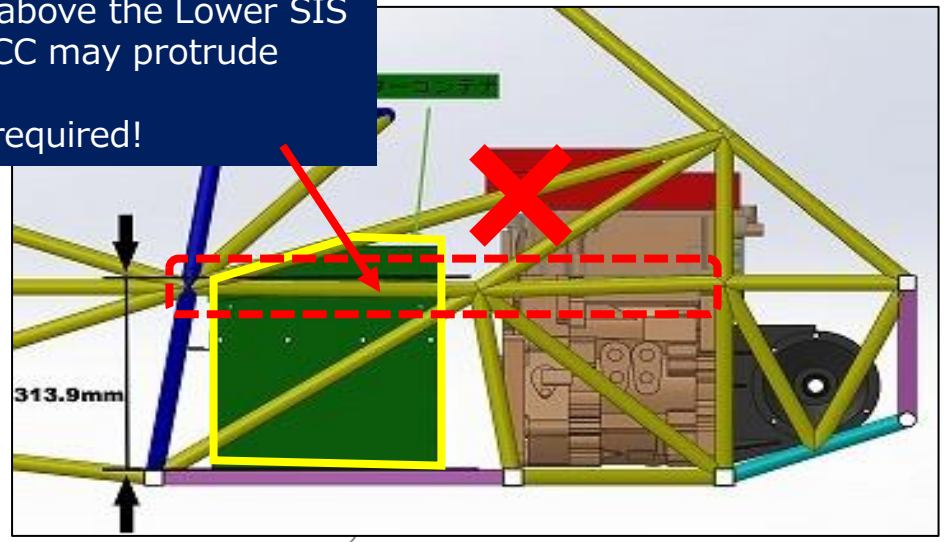
The triangulated HV protection between the SIS and Rear Impact may be as low as 240mm above the Lower SIS or the top of the accumulator, whichever is lower.
There is no maximum height.

BLANK					
F.11.2.1.a Accumulator Side Protection		**Minimum**	**Tube Used**		EQ
F.3.2.1.m	Example: 25.4mm x 1.6mm round	Size B	Round		EQ
F.3.4.1.b	Wall thickness:	1.2		mm	BLANK
	Outer Diameter (OD):	25		mm	BLANK
	Wall thickness:	1.2		mm	BLANK
	Outer Diameter (OD):	25.0		mm	BLANK
	Tube cross sectional area (A):	114		mm^2	BLANK
	Tube second moment of inertia (I):	8509		mm^4	BLANK

Input items are the same



If the red dashed pipe is at the same height as 240 mm above the Lower SIS (Upper SIS), the ACC may protrude above the pipe.
No additional pipe required!



Accumulator Side Protection

Please attach a drawing that we can check for the number you entered.

T.1.6 Heat insulation requirements apply at operating and failure temperatures.
T.1.6.3.b An air gap no less than 25mm is required between the accumulator and the driver's seat.

BLANK				
T.1.6.3.b	Air gap to driver's seat >=25mm:		mm	BLANK
	Top surface of HV Protection:			BLANK

Tractive and HV Side Protection

Please attach a drawing that we can check for the number you entered.

BLANK

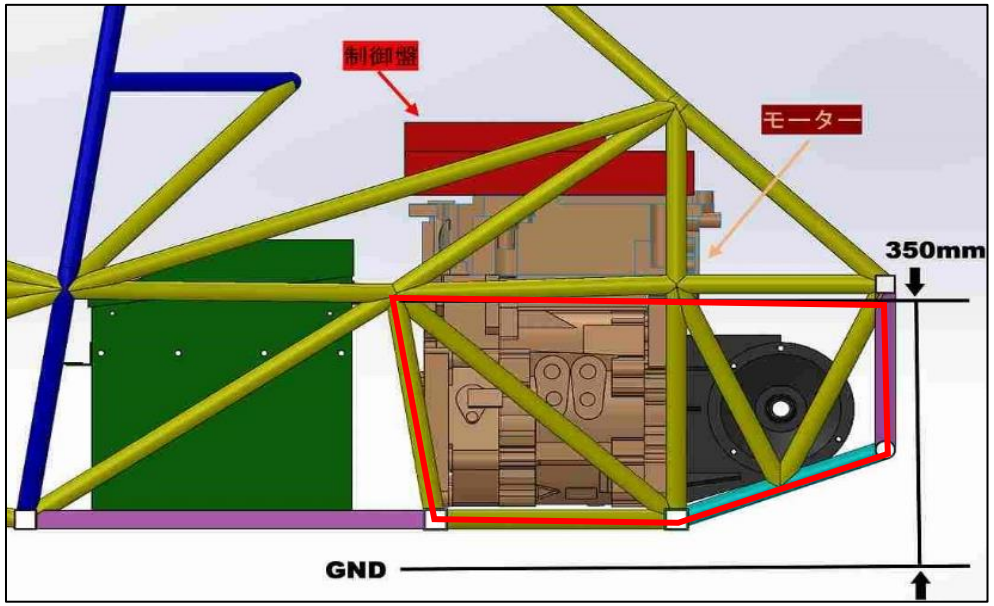
Tractive and HV Side Protection (EV Only)

This Side Protection is required at 350mm or less.

F.11.2.1.a From the side, below 350mm, all HV components must be protected with an upper tube, a lower tube, and a diagonal tube or tubes completely triangulating the upper and lower tubes.

BLANK				
F.11.2.1.b Tractive Side Protection	**Minimum**	**Tube Used**		EQ
F.3.2.1.n Example: 25.4mm x 1.2mm round	Size C	Round		EQ
F.3.4.1.c Wall thickness:	1.2		mm	BLANK
Outer Diameter (OD):	25		mm	BLANK
Wall thickness:	1.2		mm	BLANK
Outer Diameter (OD):	25.0		mm	BLANK
Tube cross sectional area (A):	91		mm^2	BLANK
Tube second moment of inertia (I):	6695		mm^4	BLANK

In the right figure, it is necessary for the zone surrounded by the red line. Similar to MHBS and FBHS, pipes of Φ25.4mm and t=1.2mm or more are required.



Please attach a drawing that we can check for the number you entered.

F.11.2.1.b The entire top edge of the upper tube must be at least 240mm above the lowest point of the top surface of the Lower SIS tube.

BLANK		
EV motor location:	Select Drop Down	BLANK
Top surface of HV Protection:		BLANK

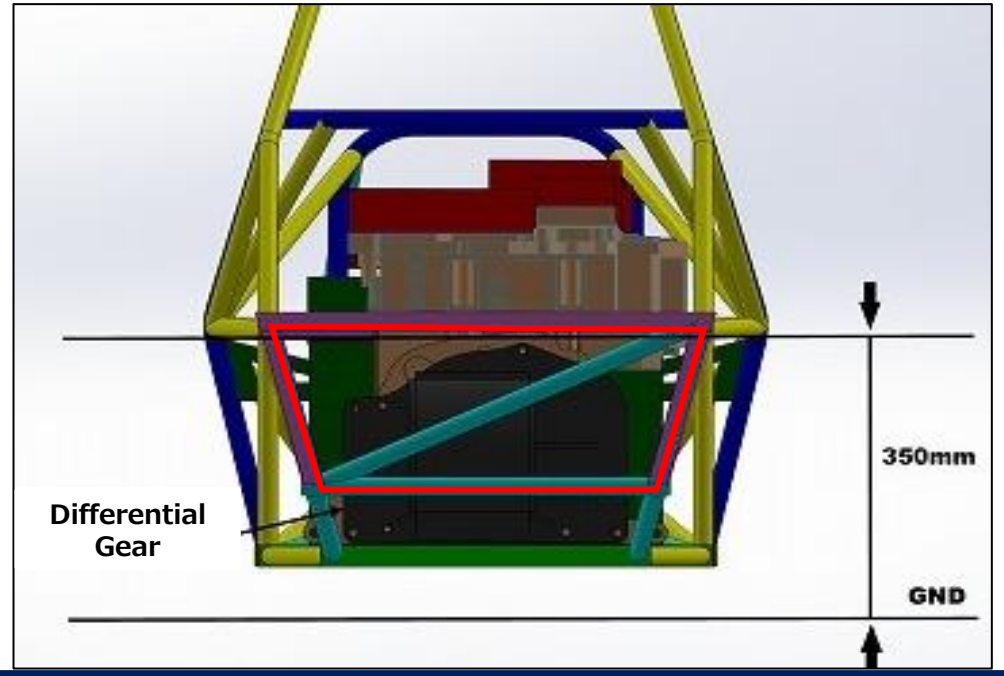
Rear Impact Protection

Please attach a drawing that we can check for the number you entered.

F.11.2.2 From the rear, below 350mm, all HV components must be protected with an upper tube, a lower tube, and a diagonal tube or tubes completely triangulating the upper and lower tubes.
Triangulation may be asymmetric.
If a plate replaces all three tubes, it must fully overlap the tractive side protection tubes.
F.11.2.2.a Increase from Size C to Size B if the accumulator is < 100mm (3.937in) from the rear impact .

This Rear Impact Protection is required below 350mm and usually requires a triangular structure.

	BLANK				
F.11.2.2.a	Min distance from Accumulator to Rear Impact?			mm	BLANK
	Accumulator Rear Impact Protection	**Minimum**	Select Drop Down		BLANK
F.3.2.1.m	Example: 25.4mm x 1.6mm round	Size B	Round		EQ
F.3.2.1.b	Wall thickness:	1.2		mm	BLANK
	Outer Diameter (OD):	25		mm	BLANK
	Wall thickness:	1.2		mm	BLANK
	Outer Diameter (OD):	25.0		mm	BLANK
	Tube cross sectional area (A):	114		mm^2	BLANK
	Tube second moment of inertia (I):	8509		mm^4	BLANK



Protection is required in the zone surrounded by a red frame in the figure.
A pipe of Φ25.4mm and t=1.6mm or more is required.

Please attach a drawing that we can check for the number you entered.

F.11.2.2.b The entire top edge of the upper tube or plate must be at least 240mm above the lowest point of the top surface of the Lower SIS tube.

BLANK			
Top surface of Lower SIS to top Rear Impact >=240mm:		mm	BLANK

Rear Impact Protection

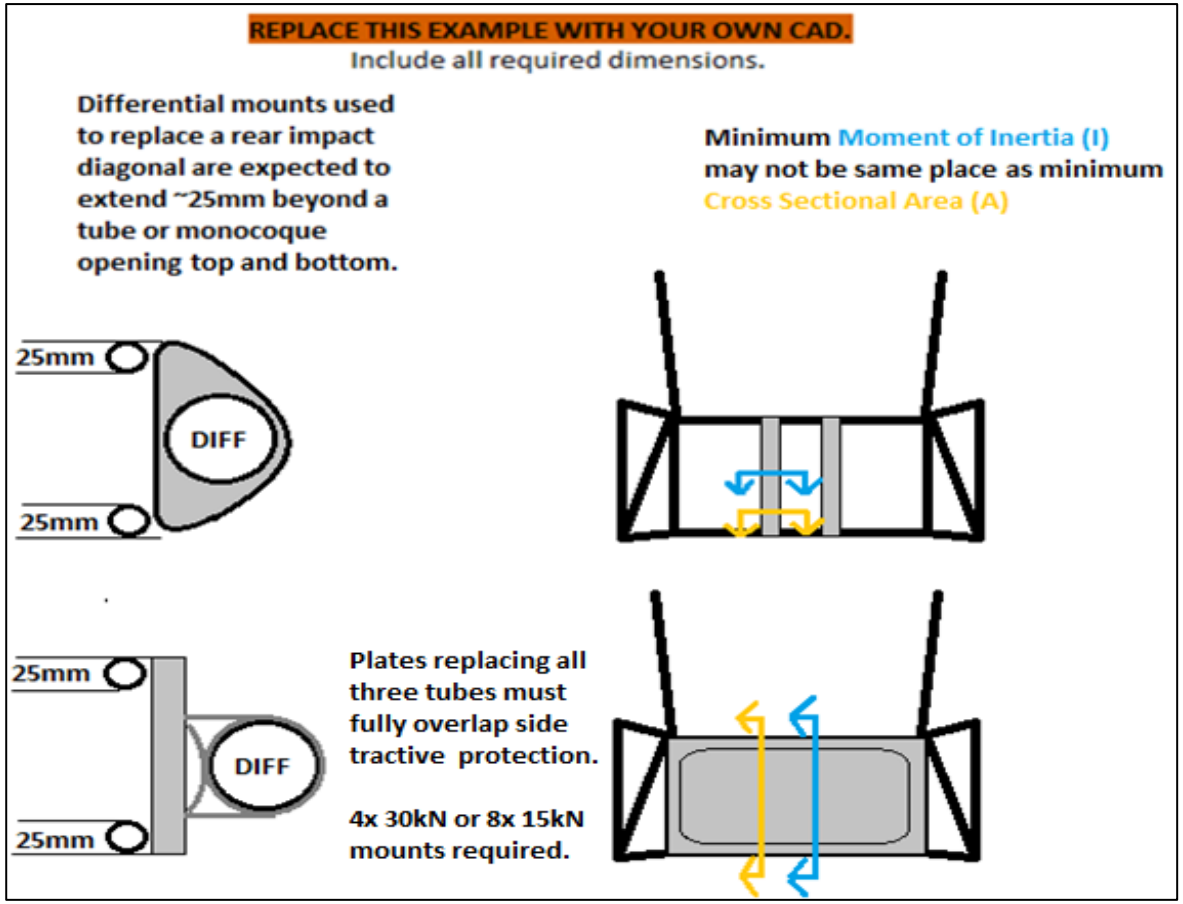
Please attach a drawing that we can check for the number you entered.

The idea of replacing the Rear Impact Protection, which consists of a normal triangular structure.

F.11.2.2.b The Rear Protection must be fully triangulated to the rest of the frame with structural tubing.
If a plate replaces all three tubes, 4x 30kN or 8x 15kN mounts are required.
Bolted joints must be documented if a removable panel or tube is used.

	BLANK				
F.11.2.2.a	**Rear Impact Tubes Replaced:**	**0**			BLANK
F.3.3-5	Material:	Steel			BLANK
F.3.4.2	Young's Modulus (E):	2.00E+11		Pa	BLANK
	Yield Strength (Sy):	3.05E+08		Pa	BLANK
	Ultimate Strength (Su):	3.65E+08		Pa	BLANK
				Pa	BLANK
		0.00E+00		mm^2	BLANK
		0.00E+00		mm^4	BLANK
	Mount longitudinal Edge to Moment of Inertia Centroid (R):	12.500		mm	BLANK
Buckling Modulus	E_1*I_1 <= E_2*I_2:	0.00E+00			BLANK
Critical Strength	S_1*A_1 <= S_2*A_2:				BLANK
Bending	4*S_1*I_1/r <= 4*S_2*I_2/r:				BLANK
Deflection	Bending_1/(48*EI):				BLANK
Energy	0.5*Bending^2/(48*EI):				BLANK

As shown in the right figure,
If the Diff Mount or Rear Bulkhead has the same or more strength in calculation, there is no need for a triangular structure pipe.



SES Guidance EV only

F.10-11 EV Accumulator

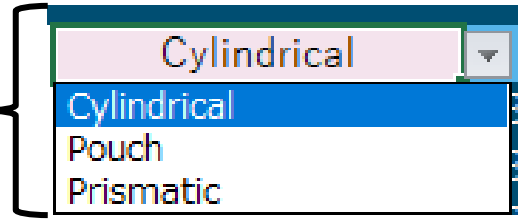
7

Accumulator Segments

This item is checked by the EV judges, but it is also checked by the SES judges.

"Voltage", "Capacity", etc. will be checked against the EV screening documents submitted in advance, so do not make any calculation mistakes.

BLANK				
	Cell type:	Cylindrical		EQ
	Maximum Voltage:		V	BLANK
	Nominal Voltage:		V	BLANK
	Nominal Capacity:		mAh	BLANK
	Maximum segment cells in series:			BLANK
	Maximum segment cells in parallel:			BLANK
EV.6.1.2	Maximum segment voltage:	0	V	EQ
EV.6.1.2	Maximum segment capacity:	0	MJ	EQ
	Total accumulator cells in series:			BLANK
	Total accumulator cells in parallel:			BLANK
EV.4.1.2	Maximum accumulator voltage:	0	V	EQ
	Maximum accumulator capacity:	0	kWh	EQ



Choose from 3 options

BLANK				
F.10.3.4 **Cell mounting and bracing material:**	E:		Pa	BLANK
	UTS:		Pa	BLANK
	Shear:		Pa	BLANK
	Assembled Segment moment of inertia, Lateral cross section:		**mm^4**	BLANK
	Assembled Segment moment, Longitudinal cross section:		**mm^4**	BLANK
	Maximum segment length:		mm	BLANK
	Maximum segment width:		mm	BLANK
	Maximum segment height:		mm	BLANK

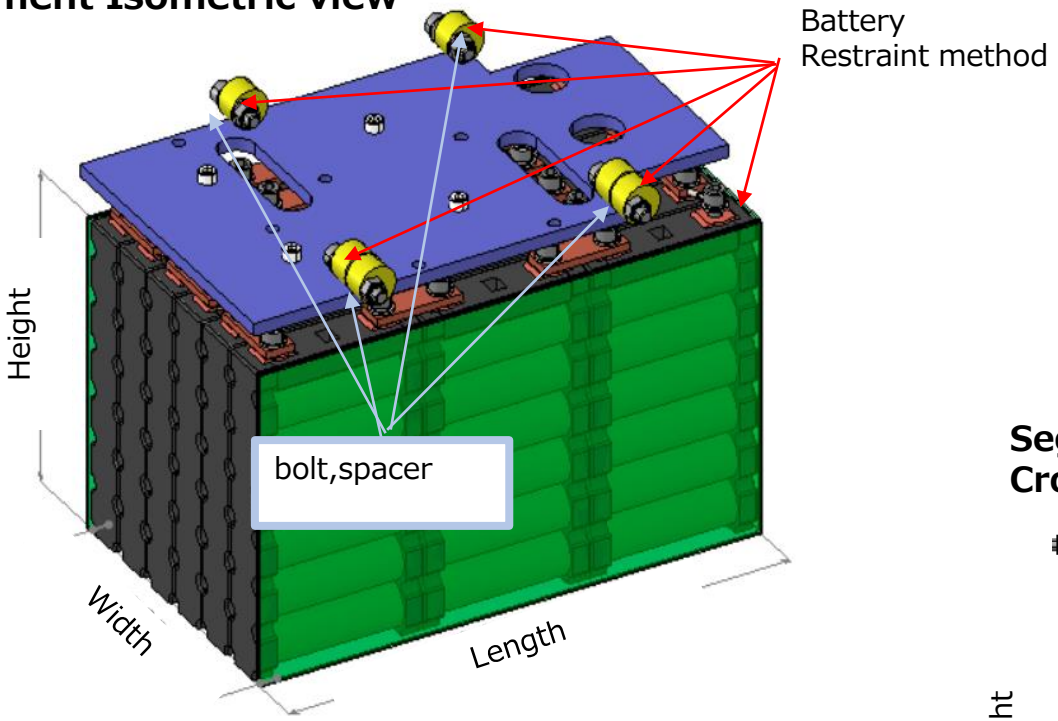
BLANK		
F.10.3.4 **Restraint Method:**	Examples: Bolted, Friction, Adhesive	BLANK

Accumulator Segments

Attach the required drawings. The addition of isometric drawings makes it easier for us to judge.

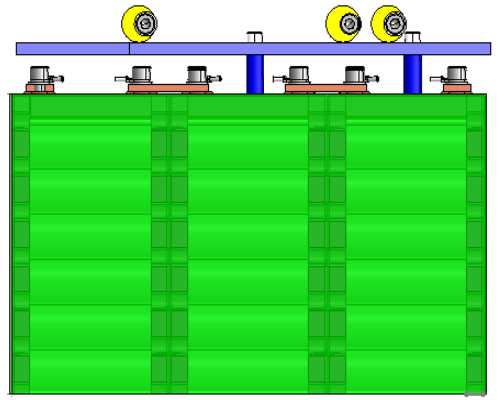
Segment lateral cross section. (Multiple if modules are not identical.)
Segment longitudinal cross section. (Multiple if modules are not identical.)
Include all dimensions entered below.

Segment Isometric view

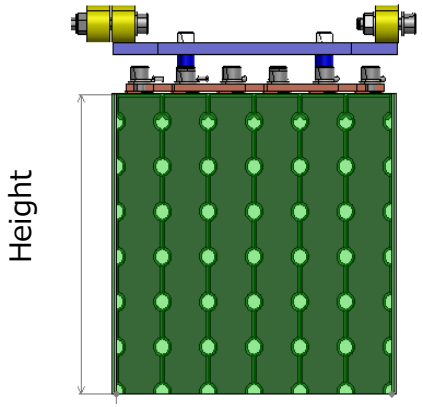


**The cited CAD drawings are very easy to understand and easy to judge.
However, details are not shown.
No need for color.**

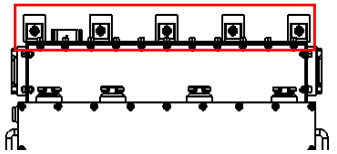
Segment Lateral Cross Section



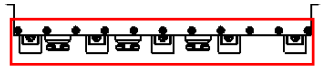
Segment Longitudinal Cross Section



ACC Restraint Method



**Describe the fixing method
(Example: bolt)**



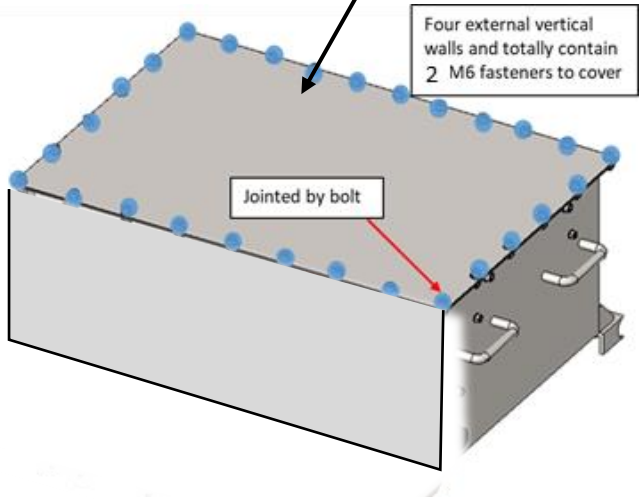
Accumulator Container

Aside from the weight item, the team should attach evidence (a CAD drawing) that shows the number entered and the joining method.

	BLANK			
	Minimum segment mass:		kg	BLANK
F.10.3.2.b	Maximum segment mass <=12kg (26.4lbs):		kg	BLANK
	Number of segments <= 8kg (17.6lbs):			BLANK
	Number of 8kg < segments <= 12kg (26.4lbs):			BLANK
F.10.3.2.d	Min fastener count in fastened connections between vertical walls:			3

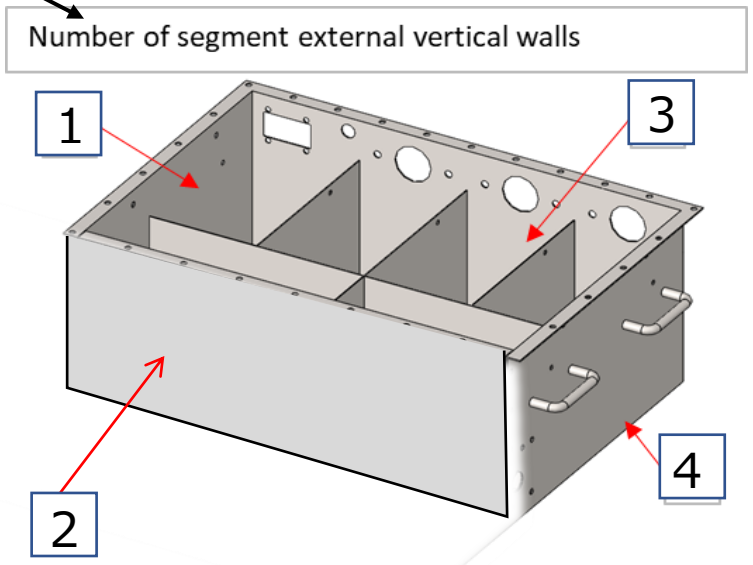
	BLANK		
F.10.2.2e	Number of segment external vertical walls:		BLANK
	Number of cover fasteners:		BLANK
F.10.3.1.d	Min 1 per segment when using fasteners between external walls and floor.		

	BLANK			
F.10.2.3	Vertical wall joining method:	Fastened		EQ
	Average unit strength of 50% weld, 0.9mm wall:	135	N/mm	N/A
F.8.5.6	Fastener shear capability:		N	BLANK
	Maximum fastener spacing:		mm	BLANK
			N/mm^2	N/A
			mm	N/A
F.10.2.3.b	Fastener shear / spacing >= Unit baseline:			EQ



In particular, the team should display Fastener numbers in a meaningful way.

Isometric drawings are easier for us to understand than three-sided drawings.



Accumulator Container

Please attach a drawing that we can check for the number you entered.

F.10.2.1 MINIMUM ACCUMULATOR FLOOR

BLANK				
	All segment floor sections >= 75% area:			BLANK
F.10.2.1	**Accumulator Floor Construction:**			EQ
	Steel: 1.25mm (0.049in), Aluminum: 3.2mm (.125in):		mm	BLANK
	Material Used:	Steel Unwelded		N/A
	Panel thickness:	0	mm	N/A
	Core thickness:		mm	N/A
	Outer skin thickness:		mm	N/A
	Inner skin thickness:		mm	N/A

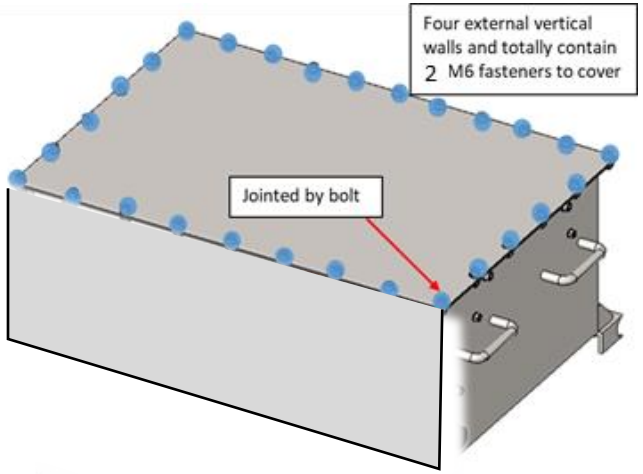
Flat Panel Properties			Flat Panel Properties			Flat Panel Properties		
Outer (b)	#REF!	m	A_1	#REF!	m^2	I_1	#REF!	m^4
Outer (h)	0	m	A_2	#REF!	m^2	I_2	#REF!	m^4
Thickness	0	m	y_1	0.000	m	Ic_1	#REF!	m^4
Inner (b)	#REF!	m	y_2	0.000	m	Ic_2	#REF!	m^4
Inner (h)	0	m	Centroid	#REF!	m	Ic_{12}	#REF!	m^4

F.10.2.2 MINIMUM ACCUMULATOR WALLS

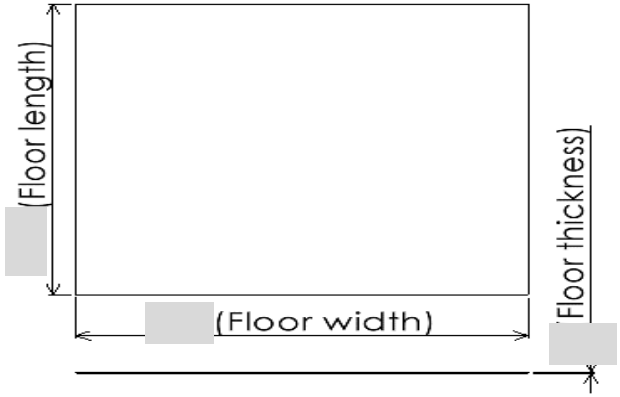
BLANK				
	All segment wall sections >= 75% area:			BLANK
F.10.2.2	**Exterior Wall Construction:**	Steel		EQ
	Steel: 0.90mm (0.035in), Aluminum: 2.3mm (0.090in):		mm	BLANK
	Material Used:	Steel Unwelded		N/A
	Panel thickness:	0	mm	N/A
	Core thickness:		mm	N/A
	Outer skin thickness:		mm	N/A
	Inner skin thickness:		mm	N/A

F.10.2.2 MINIMUM ACCUMULATOR COVER/LID

BLANK				
No accumulator holes with line of sight to driver:				BLANK
	All segment cover sections >= 75% area:			BLANK
F.10.2.2	**Accumulator Lid:**	Steel		EQ
	Steel: 0.90mm (0.035in), Aluminum: 2.3mm (0.090in):		mm	BLANK
	Material Used:	Steel Unwelded		N/A
	Panel thickness:	0	mm	N/A
	Core thickness:		mm	N/A
	Outer skin thickness:		mm	N/A
	Inner skin thickness:		mm	N/A



The team draws the floor part for the above Accumulator container and inputs the required size.



Draw Walls and Cover/Lid in the same way and enter the required size.

Accumulator Mount

Top Front, Top Rear, Bottom Front, Bottom Rear

Please attach a drawing that we can check for the number you entered.

ACCUMULATOR MOUNT: Where fastener passes through to Chassis Mount

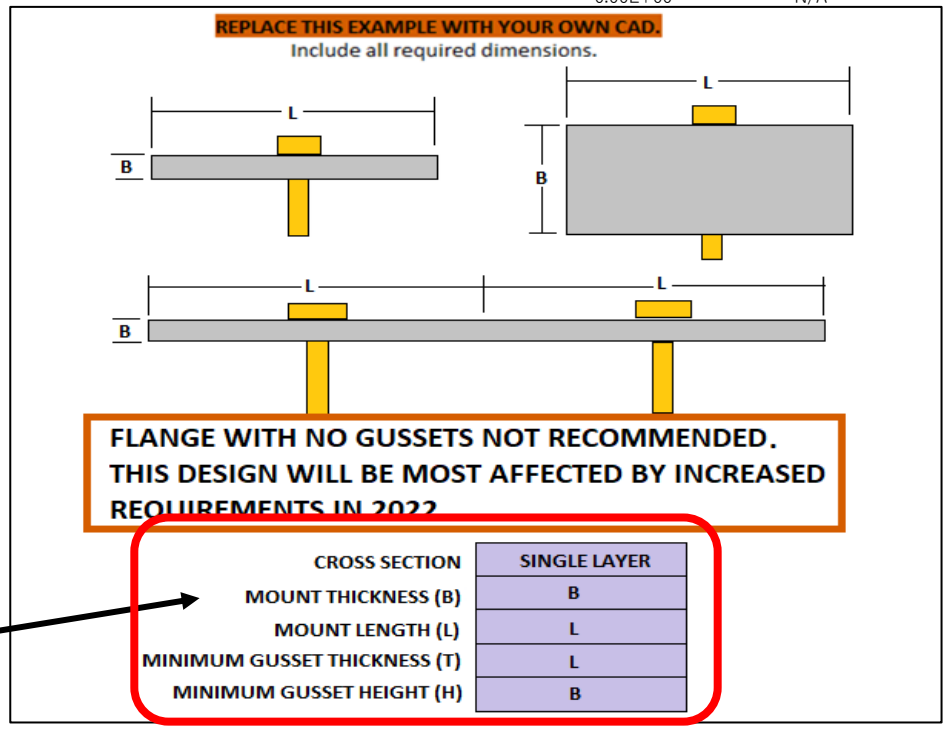
BLANK				
	Intersection of fastener axis and fastener shear plane.			EQ
Outside	the front/rear planes of the accumulator segments:		mm	BLANK
Outside	the top/bottom planes of the accumulator segments:		mm	BLANK
Outside	the left/right planes of the accumulator segments:		mm	BLANK
	Total Surface Offset, zero for an internal hardpoint:	0	mm	EQ
	Mount material (Accumulator skin if directly mounted):	Steel Unwelded		EQ
	Young's Modulus (E):	2.00E+11	Pa	EQ
	Ultimate Tensile and Bending Strength (S):	3.65E+08	Pa	EQ
	Shear:	2.11E+08	Pa	EQ
	Mounting face thickness (Do not include core.):		mm	BLANK
	Minimum - Fastener spacing, edge, or corner distance:		mm	BLANK
	Number of fasteners used (2x if in double shear):			BLANK
	Fastener diameter:		mm	BLANK
	Threads in shear:			BLANK
	Fastener shear capability:		N	BLANK
	total perimeter of all washers, inserts, brackets on one surface:		mm	BLANK
F.10.5.7.c	Fastener shear >= Test Load:	0.00E+00		EQ
	Fastener Pullout >= Test Load:	0.00E+00		EQ
	Fastener Tearout >= Test Load:	0.00E+00		EQ

MOUNT GEOMETRY - ACCUMULATOR SIDE

EQ			
	Mount cross section:		N/A
	Mount thickness (B):	mm	N/A
	Mount length (L):	mm	N/A
	Minimum gusset thickness (T):	mm	N/A
	Minimum gusset height normal to mount face (H):	mm	N/A

ACCUMULATOR MOUNT :: Accumulator Skin interface

EQ			
	Accumulator skin at mount interface:	Steel Unwelded	N/A
	Young's Modulus (E):	2.00E+11 Pa	N/A
	Ultimate Tensile and Bending Strength (S):	3.65E+08 Pa	N/A
	Shear:	2.11E+08 Pa	N/A
		mm	N/A
F.10.5.7.c			N/A
		mm	N/A
			N/A
		mm	N/A
			N/A
		N	N/A
		mm	N/A
		0.00E+00	N/A
		0.00E+00	N/A



Teams should decide by example what type the Mount Cross Section is.
In that case, please follow the illustration for each size.

Chassis Mount

Top Front, Top Rear, Bottom Front, Bottom Rear

Please attach a drawing that we can check for the number you entered.

CHASSIS MOUNT: Where fastener passes through to Accumulator Mount

BLANK				
	Intersection of fastener axis and fastener shear plane.			BLANK
	Enter 0 for centerline tube inserts or flush with a monocoque hardpoint.			EQ
	Offset from composite panel or radially from tube surface:		mm	BLANK
	Mount material (Composite skin for internal hardpoint):	Steel Unwelded		EQ
	Young's Modulus (E):	2.00E+11	Pa	EQ
	Ultimate Tensile and Bending Strength (S):	3.65E+08	Pa	EQ
	Shear:	2.11E+08	Pa	EQ
	Mounting face thickness (Do not include core.):		mm	BLANK
	Minimum - Fastener spacing, edge, or corner distance:		mm	BLANK
	Number of fasteners used (2x if in double shear):			BLANK
	Fastener diameter:		mm	BLANK
	Threads in shear:			BLANK
	Fastener shear capability:		N	BLANK
	total perimeter of all washers, inserts, brackets on one surface:		mm	BLANK
F.10.5.7.c	Fastener shear >= Test Load:	0.00E+00		EQ
	Fastener Pullout >= Test Load:	0.00E+00		EQ
	Fastener Tearout >= Test Load:	0.00E+00		EQ

TUBE CHECK: < 95% not a cause for rejection in 2022. See cell AC5.

BLANK				
	Chassis type at mount:	Tube		EQ
		Round		EQ
F.3.2.1	Chassis tube diameter:		mm	BLANK
	Chassis tube wall:		mm	BLANK
F.10.5.7.e	Number of chassis mounts on this tube:			BLANK
F.3.4.2	Ultimate Strength (Su):	3.65E+08	Pa	EQ
	Main Hoop Brace second moment of inertia (I):	0.00E+00	mm^4	BLANK
	Tube Length (L):		mm	BLANK
	Chassis mount distance to closest triangulated node (a):		mm	BLANK
F.10.1.1.a	Tube Max Bending Force (Su*L*I)/(a*(L-a)*OD/2):			BLANK

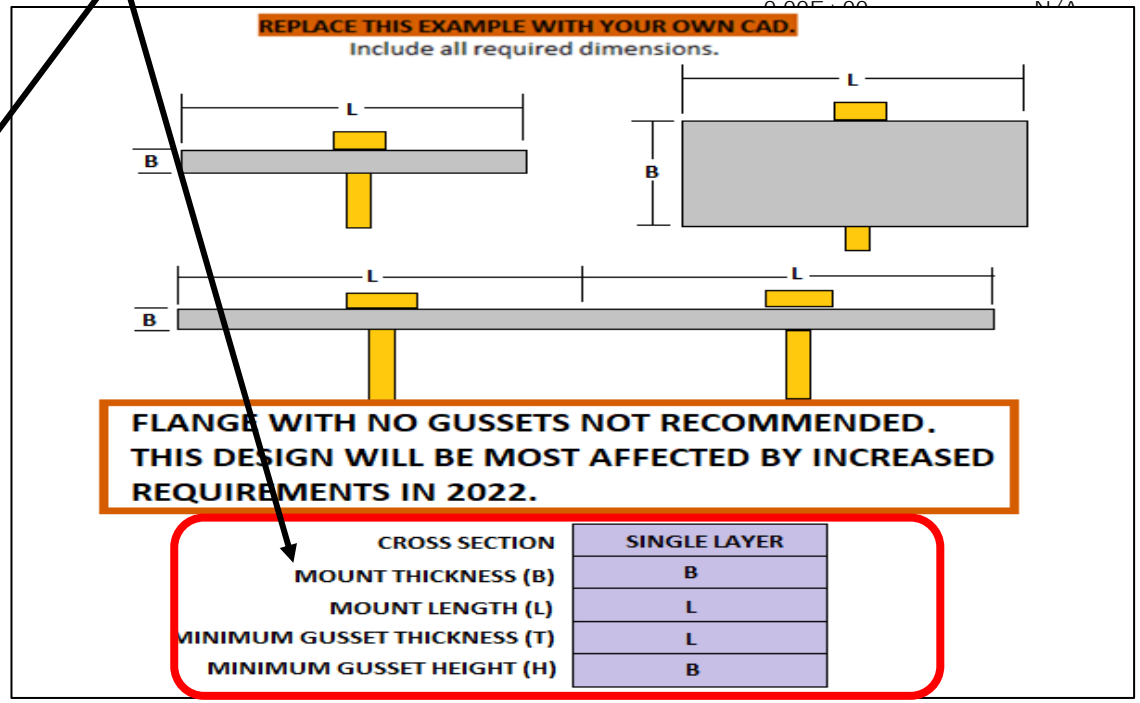
MOUNT GEOMETRY - CHASSIS SIDE

EQ				
	Mount cross section:			N/A
	Mount thickness (B):		mm	N/A
	Mount length (L):		mm	N/A
	Minimum gusset thickness (T):		mm	N/A
	Minimum gusset height normal to mount face (H):		mm	N/A
F.3.5	0.0 15000N Bending in shear M*y / I < Su:			N/A
3.65E+08	0.0 15000N Bending normal M*y / I < Su:			N/A
2.11E+08	Parabolic shear 3*Test Load/2*area <= Shear:			N/A

Chassis Mount to Chassis interface

EQ			
	Chassis wall at mount interface:	Steel Unwelded	N/A
	Young's Modulus (E):	2.00E+11 Pa	N/A
	Ultimate Tensile and Bending Strength (S):	3.65E+08 Pa	N/A
	Shear:	2.11E+08 Pa	N/A
		mm	N/A
F.10.5.7.c			N/A
		mm	N/A
			N/A

Teams should decide by example what type the Mount Cross Section is.
In that case, please follow the illustration for each size.



Attention : Chassis Mount

Top Front, Top Rear, Bottom Front, Bottom Rear

Teams are required to fill in F.3.4.3 Weld Insert sheets when drilling and fixing in the center of the Chassis pipe.

Please attach a drawing that we can check for the number you entered.

CHASSIS MOUNT: Where fastener passes through to Accumulator Mount

BLANK		
Intersection of fastener axis and fastener shear plane. Enter 0 for centerline tube inserts or flush with a monocoque hardpoint.	Centerline Inserts	EQ EQ

EQ

Any removable members along required tubes?

Tube Chassis BO133: No

EQ

Any holes over 4mm drilled in F.3.2.1 required tubes?

Tube Chassis BO134: No

AIP Inserts: No

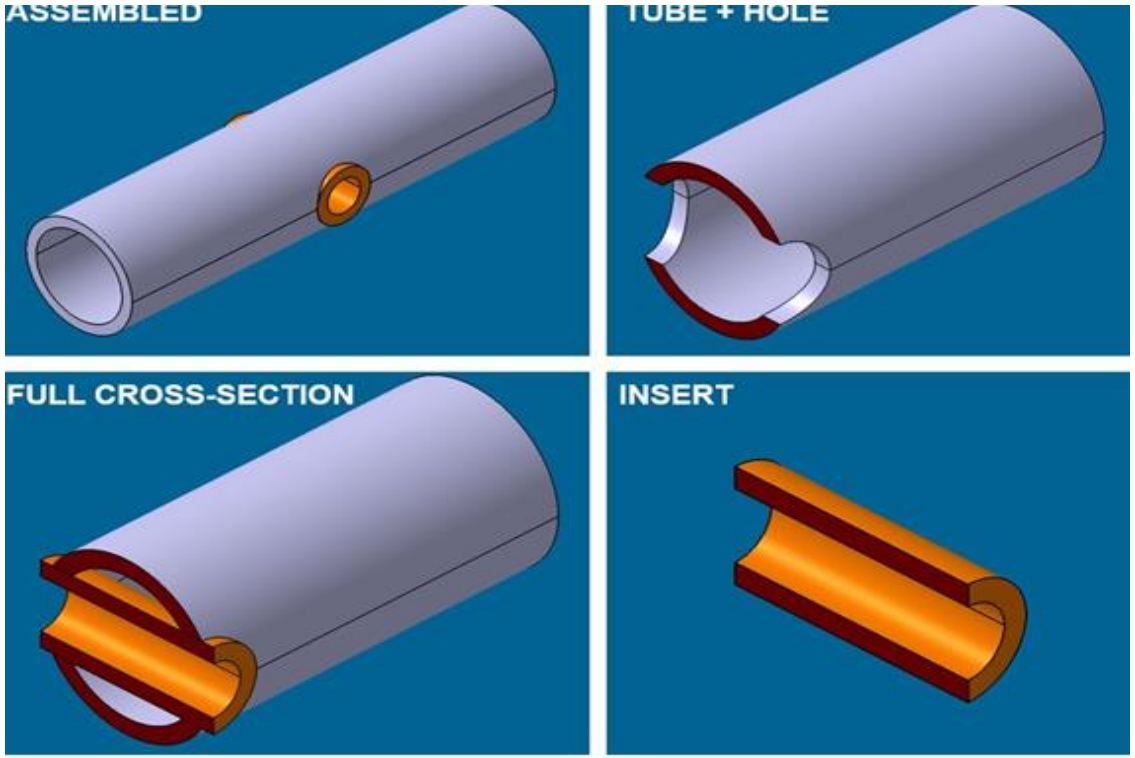
EV Accumulator: Yes

EQ

Does the steering rack interrupt any required tubes?

Tube Chassis BO135: No

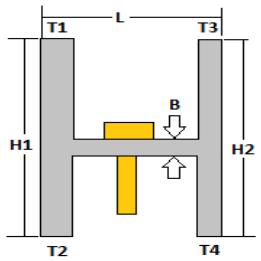
FILL OUT THIS TAB.



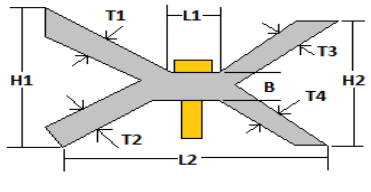
Chassis Mount

Select your team's Offset Mount type from the attached illustration.

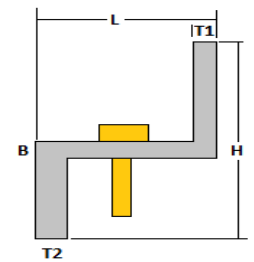
MOUNT EXAMPLES WITH ONE BRACE / GUSSET



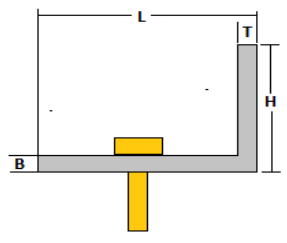
H-SHAPE	
(B)	B
(L)	L
(T)	min (T1, T2, T3, T4)
(H)	min (H1, H2)



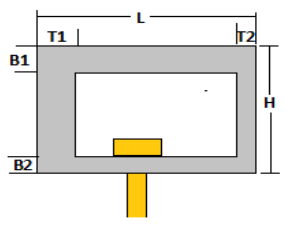
H-SHAPE	
(B)	B
(L)	average (L1, L2)
(T)	min (T1, T2, T3, T4)
(H)	min (H1, H2)



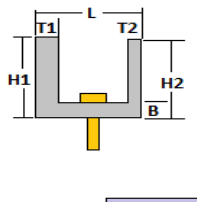
H-SHAPE	
(B)	B
(L)	L
(T)	0.5 x min (T1, T2)
(H)	H

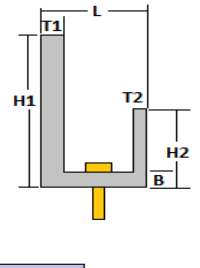


L-SHAPE	
(B)	B
(L)	L
(T)	T
(H)	H

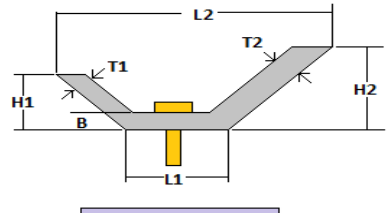


RECTANGULAR TUBE	
(B)	min (B1, B2)
(L)	L
(T)	min (T1, T2)
(H)	H





U-SHAPE	
(B)	B
(L)	L
(T)	min (T1, T2)
(H)	min (H1, H2)

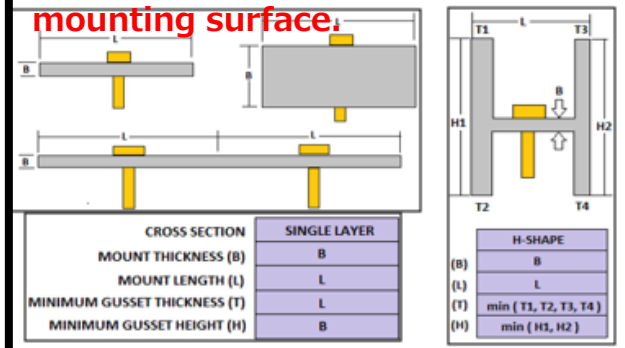


U-SHAPE	
(B)	B
(L)	average (L1, L2)
(T)	min (T1, T2)
(H)	min (H1, H2)

In these figures, the gray hatched surface is the tab mounting surface, and the vertical direction of the bolt is the direction in which the load is applied.

SES guidance_"Front + Protection“ See also AIP Attachment.

The gray hatched surface is the tab mounting surface.

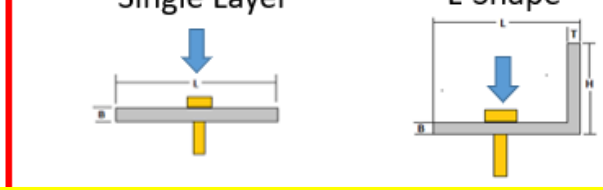


CROSS SECTION	SINGLE LAYER
MOUNT THICKNESS (B)	B
MOUNT LENGTH (L)	L
MINIMUM GUSSET THICKNESS (T)	L
MINIMUM GUSSET HEIGHT (H)	B

H-SHAPE	
(B)	B
(L)	L
(T)	min (T1, T2, T3, T4)
(H)	min (H1, H2)

L-SHAPE	
(B)	B
(L)	L
(T)	T
(H)	H

U-SHAPE	
(B)	B
(L)	L
(T)	min (T1, T2)
(H)	min (H1, H2)



Teams should decide how to attach the Tab to the FHB, interpreting the gray mounting surface as bearing the load in the direction of the arrow.

Examples of L-Shapes